

HABITAT OF RESTIONACEAE ENDEMIC TO WESTERN CAPE COASTAL FLATS

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ABSTRACT

Chondropetalum acockii and *Restio micans* (family Restionaceae) are endemic to the western coastal flats of the south-western Cape. Both species are associated with Coastal Fynbos on sand. The habitats of *C. acockii* and *R. micans* are described and compared using associated plants (Restionaceae and Proteaceae) as an expression of environmental conditions.

UITTREKSEL

HABITAT VAN RESTIONACEAE ENDEMIES OP DIE WESTELIKE KAAPSE KUSVLAKTES

Chondropetalum acockii en *Restio micans* (familie Restionaceae) het 'n beperkte verspreiding op die westelike kusvlakte van Suidwes-Kaapland. Die twee spesies kom op kushfynbos van die sandveld voor. Die habitat van beide *C. acockii* en *R. micans* word beskryf en met mekaar vergelyk op grond van geassosieerde plantsoorte (Restionaceae en Proteaceae) as weerspieëling van omgewingstoestande.

INTRODUCTION

The Restionaceae are a family physiognomically and floristically characteristic of the south-western Cape's distinctive fynbos vegetation, yet their phytogeography and ecology are relatively poorly documented (Weimarck, 1941; Taylor, 1969, in press; Boucher, 1972). Phytocenological work on Cape fynbos in a coastal area has shown that "the correlation between soil, topography and vegetation is extremely good" (Taylor, 1969). Members of the Restionaceae are regarded as particularly valuable for the recognition of fynbos communities (Taylor, 1969, 1972, in press; Boucher, 1972), partly owing to their apparently greater habitat-specificity than other elements of the flora (Taylor, 1969).

Among the 281 described southern African Restionaceous species (Pillans, 1928, 1942, 1945, 1952) only *Chondropetalum acockii* Pillans, *Restio micans*

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(Kunth) Nees and *R. acockii* Pillans are endemic to the western coastal flats of the south-western Cape. These flats were arbitrarily defined here as from False Bay northwards, west of the Hottentots-Holland-Winterhoek mountain chain to S 32° 30' (the latitude of Piketberg) and eastwards along the intermontane flats to Worcester between sea level and 600 m. The flats have been extensively changed by man, with a consequent decrease in the populations of indigenous plant species. *Chondropetalum acockii* and *R. micans* appear to be in danger of extinction, owing chiefly to land development and the spread of invasive alien *Acacia* species, while *R. acockii*, known only from the type locality near Bellville, appears already to be extinct. Four other species in the Restionaceae have ranges almost restricted to the western flats as defined above. *Leptocarpus impolitus* (Kunth) Pillans and *Thamnochortus punctatus* Pillans occur on sandy substrates northwards to Graafwater and Niewoudtville; *Elegia prominens* Pillans occupies similar environments from Darling southwards to the coastal shelf near Cape Point and Cape Hangklip. *Restio duhiae* Pillans, occurring on clay-rich substrates, extends eastwards along the intermontane flats of the Breede River to Worcester (Rare and Endangered Species Research Group, unpublished). These species are less critically threatened than are *C. acockii* and *R. micans* owing to their wider occurrence.

This paper is the first of a series dealing with the habitat of coastal flats endemics, their intensive study being an urgent prerequisite for their conservation. The aim of this study was to characterize the habitats of *C. acockii* and *R. micans*. We attempted to arrive at a reliable reflection of environmental conditions by a qualitative floristic method, recording the confamilial members of the vegetation associated with these two species. Members of the Proteaceae, also characteristic of fynbos (Taylor, in press), were recorded as an additional sample of the total set of taxa represented in the vegetation, for the purposes of habitat expression.

METHODS

All distribution records for the two study species, *Chondropetalum acockii* and *Restio micans*, were obtained from the literature, Cape herbarium material and unpublished records of the Rare and Endangered Species Research Group. All recorded localities were visited and three populations of each study species were relocated, "populations" of a species being arbitrarily defined as stands farther than 2 km apart. These extant populations appeared to represent all parts of the known distribution for each species.

The physiognomy of associated vegetation, site topography and a qualitative description of soil were recorded on site for each population. Average annual precipitation and altitude were also recorded, using the best maps available.

Indirect (floristic) information was mainly used in documenting the habitats of the two study species, both of which are leafless grass-like perennials. *Chondropetalum acockii* grows as 0,7–0,8 m tussocks of unbranched stems, arising from a base consisting of creeping rhizomes; *R. micans* grows as 0,3–0,5 m slender tufts

of sparingly branched stems arising from a simple base. All members of the Restionaceae and Proteaceae growing within 0.25 m of plants of each study species were recorded, thereby collecting data only from within the edaphic environment of the study species. This search for associates was continued until all, or a minimum of 12, study plants in each of the three populations of each study species had been investigated. Lists, according to presence or absence, of associate species for each population were combined to show the "between-population frequency" of each associate for each study species. Examples of associates in other families were recorded where possible.

RESULTS AND DISCUSSION

1. *Habitat of Chondropetalum acockii* Pillans*

Chondropetalum acockii had a restricted range on the western coastal flats of the south-western Cape, from Bellville to Mamre Road (Fig. 1). The species was confined to deep, pale, transported sand of Tertiary origin on level and gently sloping sites. Populations were at altitudes of 90–120 m and received annual precipitation of 450–550 mm.

The vegetation associated with *C. acockii* was a mainly restioid-ericoid (*sensu* Taylor, in press) Coastal Fynbos, 1.0–1.5 m high. The floristic composition of the vegetation associated with the three populations appeared similar. Examples of species in common were *Diosma oppositifolia*, *Muraltia brevicornu*, *Phylica stipularis*, *Staavia radiata*, *Berzelia abrotanoides* and several members of the Restionaceae and Proteaceae (Table 1).

Chondropetalum acockii occurred near Mamre Road as a conspicuous member of an open stand (canopy cover 70–80 %) comprising a main 0.8 m stratum of ericoid shrubs (e.g. *Phylica cephalantha*, *Elytropappus gnaphaloides*, *Metalasia* spp.) and tufted restioids (e.g. *Thamnochortus punctatus*). Proteoid shrubs of *Leucospermum parile* formed a more open upper stratum to 1.2 m, while scattered spindly shrubs of *Muraltia brevicornu* emerged to 1.5 m. Populations of *C. acockii* near Philadelphia and Bellville occurred in stands similar in structure; *Leucospermum parile* was, however, absent, the proteoid stratum being reduced to widely scattered shrubs of *Leucadendron salignum* or *Protea repens*. The set of plant species collectively associated with *C. acockii* (Table 1, Appendix 1a) bore little resemblance to those representing described communities of other sandy coastal flats (Taylor, 1969, 1972; Boucher, 1972; Boucher & Jarman, 1977), none of which cover the area of distribution of *C. acockii*.

2. *Habitat of Restio micans* (Kunth) Nees

Restio micans had a restricted range on the western coastal flats of the south-western Cape, occurring on the Cape Flats, near Bottellary and near Mamre

*collections of voucher specimens of the study species and their associates are housed at the Bolus Herbarium, University of Cape Town.



Road (Fig. 1). The species was confined to pale, transported sand of Tertiary origin on level sites. Populations were at altitudes of 20–125 m and received annual precipitation of 450–850 mm. *Restio micans* occurred in small shallow depressions and at the base of gentle slopes, where the substrate was seasonally waterlogged owing to drainage poorer than on adjacent sandy ground.

The vegetation associated with *R. micans* was a mainly restioid Coastal Fynbos, 0.5–1.8 m high. The floristic composition of the associated vegetation appeared heterogeneous; few species were noted as common to two or more of the three populations, other than several members of the *Restionaceae* and *Proteaceae* (Table 1).

Restio micans occurred near Kenilworth as a conspicuous member of a stand resembling Taylor's (1969) *Restionaceous* Tussock Marsh Association. Species in common included *Elegia parviflora*, *Restio quinquefarius*, *R. bifurcus*, *Chondropetalum nudum*, *Erica corifolia*, *Scyphogyne muscosa*, *Cliffortia subsetacea*, *Serruria glomerata* and *Berzelia abrotanoides*. Taylor's *Restionaceous* Tussock Marsh Association occurs on the southern Cape Peninsula in shallow depressions and on drainage line flats, on transported sand and on soils ("Cartref" and "Witsand") derived from Table Mountain Sandstone (Taylor, 1969). It is associated with poor drainage, "where water is stagnant during winter but dries up during summer" (Taylor, 1969). Sets of plant species associated with other populations of *R. micans* (Table 1, Appendix 1b) bore little resemblance to those representing described communities. Associates of *R. micans* considered characteristic of moist edaphic conditions include *Fuirena hirsuta*, *Gladiolus angustus*, *Drosera trinervia*, *Berzelia abrotanoides*, *Psoralea pinnata*, *Helichrysum serpylli-*

FIG. 1*

The south-western Cape, modified after Talbot (1971) and Acocks (1975), showing distribution of *Chondropetalum acockii* (○) and *Restio micans* (Δ) in relation to biotic areas. Stippled areas are mountains largely of Table Mountain Sandstone covered mainly by Mountain Fynbos (Acocks' *Macchia*). 1 = "sandveld" (including the Cape Flats and Fish Hoek valley), flats of Tertiary to Recent sand covered mainly by Coastal Fynbos (Acocks' *Coastal Macchia*) (1a = that part covered mainly by Acocks' *Coastal Rhenosterbosveld*, delineated by dotted line); 2 = "swartland", flats of Malmesbury shale covered mainly by Coastal Rhenosterbosveld; 3 = "voorberg" and coastal flats of the Cape Peninsula (a foothill zone intermediate between the mountains and areas 1 & 2); 4 = "Bréérivier Valley", intermontane flats of Malmesbury shale. Recent sand and alluvial deposits, covered by vegetation of mixed affinities; (4) = area 4 east of Worcester; 5 = "ruëns", southern coastal flats, largely of Bokkeveld shale and covered mainly by Coastal Rhenosterbosveld and Coastal *Macchia*. The "western Cape coastal flats" here comprise areas 1, 2, 3 and 4 (excluding (4)). Data were collected at all localities shown for the two study species. Localities mapped here extend the recorded distributions of *C. acockii* and *R. micans* to the north; both species were previously known only from the Cape Flats (Weimarck, 1941), where most populations at the localities shown have disappeared under urban development.

*TALBOT, W. J., 1971. *The South African Landscape*. 1. South African Geographical Society.

TABLE 1

Restionaceous and Proteaceous associates of *Restio micans* (column 1) and *Chondropetalum acockii* (column 2). Occurrence values show between-population frequency of associates: numerator is number of populations in which the associate was found within 0.25 m of plants of study species, denominator is total number of populations of study species ('+' indicates associates found in the vicinity of the study species, but not within 0.25 m). Mean number of study plants investigated per population was 56 for *R. micans* (range 12-75) and 54 for *C. acockii* (range 22-65).

Associate species	Occurrence with study species	
	1	2
<i>Restio macer</i> Kunth	+	
<i>Elegia neesii</i> (Mast.) Mast.	+	
<i>Elegia prominens</i> Pillans	+	
<i>Serruria glomerata</i> R.Br.	1/3	
<i>Leucadendron levisanus</i> (L.) Berg	1/3	
<i>Restio tetragonus</i> Thunb.	1/3	
<i>Restio quinquefarius</i> Nees	2/3	+
<i>Leucadendron cinereum</i> (Solander ex Ait.) R.Br.	2/3	+
<i>Elegia parviflora</i> Kunth.	2/3	+
<i>Restio triticeus</i> Rottb.	1/3	+
<i>Restio paludosus</i> Pillans	3/3	1/3
<i>Staberoha cernua</i> (L.f.) Dur. & Schinz	2/3	1/3
<i>Thamnochortus obtusus</i> Pillans	1/3	1/3
<i>Hypodiscus aristatus</i> (Thunb.) Nees	1/3	1/3
<i>Serruria ciliata</i> R.Br.	1/3	1/3
<i>Chondropetalum tectorum</i> (L.) Pillans	1/3	1/3
<i>Leucadendron salignum</i> Berg.	1/3	1/3
<i>Thamnochortus gracilis</i> (Dur. & Schinz) Mast.	1/3	1/3
<i>Chondropetalum nudum</i> (Nees) Rottb.	2/3	2/3
<i>Serruria burmannii</i> R.Br.	+	+
<i>Willdenowia sulcata</i> Mast.	2/3	3/3
<i>Restio bifurcus</i> Nees ex Mast.	2/3	3/3
<i>Leucospermum hypophyllocarpodendron</i> (L.) Druce ssp. <i>canaliculatum</i> (Buek ex Meisn.) Rourke	2/3	3/3
<i>Restio cuspidatus</i> Thunb.	1/3	2/3
<i>Diastella proteoides</i> (L.) Druce	1/3	2/3
<i>Serruria decipiens</i> R.Br.	1/3	2/3
<i>Thamnochortus punctatus</i> Pillans	1/3	3/3
<i>Leptocarpus impolitus</i> (Kunth) Pillans	1/3	3/3
<i>Staberoha distachya</i> (Rottb.) Kunth	1/3	3/3
<i>Protea pulchra</i> Rycroft	+	1/3
<i>Willdenowia humilis</i> Mast.	+	1/3
<i>Hypodiscus willdenowia</i> (Nees) Mast.	+	1/3
<i>Elegia vaginulata</i> Mast.		1/3
<i>Restio filiformis</i> Poir.		1/3
<i>Restio form of sieberi</i> Kunth		1/3
<i>Restio monanthus</i> Mast.		1/3
<i>Protea acaulos</i> Thunb.		1/3
<i>Protea repens</i> (L.) L.		1/3
<i>Serruria linearis</i> Salisb. ex Knight		1/3
<i>Leucospermum parile</i> (Salisb. ex Knight) Sweet		1/3
<i>Cannomois acuminata</i> (Thunb.) Pillans		1/3
<i>Leptocarpus vimineus</i> (Rottb.) Pillans		2/3
<i>Willdenowia arescens</i> Kunth		2/3
<i>Serruria furcellata</i> R.Br.		+
<i>Protea scolymoecephala</i> Reich.		+

folium, *Senecio halimifolius* and *Leucadendron levisanus* (Taylor, 1969; Lewis & Obermeyer, 1972; Williams, 1972; Bolus Herbarium mounted specimen labels).

3. Habitat similarity

Chondropetalum acockii and *Restio micans* have broadly overlapping geographical ranges, occurring in the same landscapes in several areas (Fig. 1). They grow within 30 m of each other near Mamre Road but were never found to be mutual associates (Table 1).

Percentage similarity between the set of associates for *Chondropetalum acockii* and that for *Restio micans* is shown in Table 2. The value calculated using information on the differences between populations (between-population frequency of associate species) was similar to that using coarser information only on collective presence or absence of associates.

TABLE 2

Percentage similarity between set of Restionaceous and Proteaceous associates for *Restio micans* and that for *Chondropetalum acockii*, using the Czekanowski coefficient. The formula used was $\frac{2w}{A+B} \times 100$ (Bray & Curtis, 1957), where w=number of associates in common, A=number of associates for *R. micans* and B=number of associates for *C. acockii*. Total numbers of associate species ("+" data, Table 1, ignored) were 24 for *R. micans* and 32 for *C. acockii*.

According to presence or absence	According to between- population frequency
63,2 %	51,8 %

The habitats of the two study species thus appear to be 51,8 % similar, assuming (i) that relative similarity of (natural) stands of vegetation reflects relative similarity of habitats, within a single geographical area (*vide* Webb *et al.*, 1970), and (ii) that qualitative (frequency) floristic data, restricted to two sample families, convey adequate information about the vegetation.

This numerical assessment of habitat similarity agreed with our field impression based on the appearance of the vegetation, local topography and soil conditions, and the spatial relationship between the two study species. *Chondropetalum acockii* occurred on sand apparently better drained than that for *R. micans*; in support of this, *Elegia parviflora*, characteristic of poorly drained sites (Taylor, 1969) was associated with *R. micans* but not with *C. acockii*. Several species probably indicative of perennial soil moisture owing to poor drainage, e.g. *Berzelia abrotanoides* and *Chondropetalum nudum* (Taylor, 1969) were, nevertheless, associated with both study species. This supports our impression that the restricted range and very localized occurrence of *C. acockii* is, as with *R. micans*, indicative of a discrete attachment to an edaphic environment moister than that

characterizing the major part of the western sandy flats covered by Coastal Fynbos. The two study species thus appear to be restricted to (adjacent) narrow ranges along a gradient in soil moisture.

CONCLUSIONS

The geographical distributions of *Chondropetalum acockii* and *Restio micans* were originally very restricted. Localities have been destroyed by urban development and agriculture, further reducing the species' ranges and making knowledge of their habitats essential for conservation. Remaining populations, apparently temporarily saved from ploughing by the depth of sand on which they grow, do not occur in any entrenched nature reserve and are threatened by a number of factors, chiefly encroachment by alien *Acacia* species.

Chondropetalum acockii and *R. micans* occupy mutually discrete habitats within a single biotope, viz. Coastal Fynbos on sand. Both species occur near Mamre Road, as comparatively extensive (1–2 ha) adjacent populations. A single carefully placed reserve of 10–15 ha in this area, embracing variations of drainage, slope and depth of sand, could possibly save both species from extinction. Other remaining populations, notably one of *R. micans* at Kenilworth Race Course, should also be strictly preserved to maintain maximal gene pools for the species.

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Appendix 1a

Examples of plant taxa (excluding Restionaceae and Proteaceae) associated with *Chondropetalum acockii* (order after Engler & Prantl). All taxa were recorded within 0.25 m of plants of *C. acockii*.

Ehrharta gigantea Thunb., *Plagiochloa uniolae* (L.f.) Adamson & Sprague, *Ficinia secunda* (Vahl) Kunth., *Tetaria* spp. indet., *Thesium aggregatum* A. W. Hill, *Polypoda capensis* Presl., *Cassytha ciliolata* Nees, *Berzelia abrotanoides* Brongn., *Staavia radiata* Dahl., *Cliffortia falcata* L.f., *Aspalathus quinquefolia* L. ssp. *virgata* (Thunb.) Dahlgr., *Pelargonium triste* Ait., *Adenandra villosa* (Berg.) Licht. ex Roem. & Schult. ssp. *biseriata* (Mey. ex Bartl. & Wendl.) Strid, *Agathosma imbricata* Willd., *Diosma oppositifolia* L., *Euchaetis dubia* Sond., *Macrostylis villosa* Sond., *Muraltia brevicornu* DC., *Clusia ericoides* Thunb., *Phylla cephalantha* Sond., *P. stipularis* L., *Stylapteris fruticulosus* (L.f.) A. Juss., *Cryptadenia grandiflora* Meisn., *Lachnaea capitata* Meisn., *Passerina vulgaris* Thoday, *Struthiola ciliata* Lam., *Erica crenata* E. Mey. ex Smith, *E. mammosa* L., *Salaxis* sp. indet., *Stilbe ericoides* L., *Agathelpis dubia* (L.) Hutchinson, *Anthospermum* sp. aff. *A. aethiopicum* L., *Disparago lasiocarpa* Cass., *Elytropappus gnaphaloides* (L.) Levyns,

Eroeda capensis (L.) Levyns, *Metalasia imbricata* (Berg.) Harv., *M. muricata* (L.) Don and *Stoebe gomphrenoides* Berg.

Appendix 1b

Examples of plant taxa (excluding Restionaceae and Proteaceae) associated with *Restio micans*. All taxa were recorded within 0.25 m of plants of *R. micans*.

Cynodon dactylon (L.) Pers., *Stenotaphrum secundatum* (Walt.) O. Kze., *Fuirena hotten-tota* (L.) Druce (*F. hirta* Vahl), *Scirpus* sp. indet., *Juncus* sp. indet., *Aristea africana* (L.) Hoffmg., *Gladiolus angustus* L., *Lampranthus reptans* (Ait.) N. E. Br., *Ruschia sarmentosa* (Han.) Schwant., *Drosera trinervia* Spreng., *Berzelia abrotcnoides* Brongn., *Staavia radiata* Dahl, *Cliffortia polygonifolia* L., *Aspalathus* spp. indet., *Psoralea pinnata* L., *Passerina vulgaris* Thoday, *Erica articularis* L., *E. corifolia* L., *E. ferrea* Berg., *E. imbricata* L., *E. margaritacea* Soland. ex Ait., *E. pulchella* Houtt., *Scyphogyne muscosa* (Ait.) Druce, *Stilbe ericoides* L., *Lightfootia* sp. indet., *Lobelia capillifolia* (Presl) A. DC., *Helichrysum serpyllifolium* (Berg.) Pers. (*H. orbiculare* (Thunb.) Druce), *Metalasia imbri-cata* (Berg.) Harv. and *Stoebe gomphrenoides* Berg.

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